SECTION 21

SAFE ACCESS AND FALL PROTECTION

21.A GENERAL

21.A.01 Safe access shall be provided to all work areas.

a. Where there is a horizontal or vertical break of 48 cm (19 in) or more in a route of access, a stairway, ladder, ramp, or personnel hoist shall be provided.

b. Means of access constructed of metal shall not be used for electrical work or where they might contact electrical conductors.

c. When a structure has only one means of access between levels, that means shall be kept clear to permit free passage of employees: if work is performed in an area that restricts free passage, a second means of access shall be provided.

d. When a structure has two or more means of access between levels, at least one means of access shall always be available for free passage of employees.

21.A.02 The hazard analysis, approved by the designated authority, for the activity in which means of access are to be used shall delineate the following:

a. the design, construction, and maintenance of the means of access, and

b. erection and dismantling procedures, including provisions for providing fall protection during the erection or dismantling when the erection or dismantling involves work at heights <u>which expose the workers to falls of</u> 1.8 m (6 ft) or more.

21.A.03 Job-made means of access shall be designed to support, without failure, at least four times the maximum intended load.

21.A.04 Means of access shall not be loaded beyond the maximum intended load for which they were designed or beyond their manufactured rated capacity: when loaded, planking and decking shall not deflect more than 1/60 the span length.

21.A.05 The width of accessways shall be determined by the purpose for which they are built and shall be sufficient to provide safe passage for supplying materials and movement of personnel: except for ladders, in no case shall the width be less than 46 cm (18 in). ***> See 21.D.02***

21.A.06 Load-carrying timber members shall be a minimum of 3.1 m€ MPa (1,500 lb-ft/in$^{2)}$ (stress grade) construction grade lumber.

a. All dimensions are nominal sizes (except where rough sizes are noted) as provided by NBS Voluntary Product Standard PS 20-70, American Softwood Lumber Standard, published by the National Bureau of Standards of the US Department of Commerce: where rough sizes are noted, only rough or undressed lumber of the size specified will satisfy minimum requirements.

b. Lumber shall be reasonably straight-grained and free of shakes, checks, splits, cross grains, unsound knots or knots in groups, decay and growth characteristics, or any other condition which will decrease the strength of the material.

21.A.07 Supporting members and foundations shall be of sufficient size and strength to safely distribute loading.

a. Supporting members shall be placed on a firm, smooth foundation that will prevent lateral displacement.

b. Unstable objects such as barrels, boxes, loose bricks, or concrete blocks shall not be used as supports.

21.A.08 Vertical members (e.g., poles, legs, or uprights) shall be plumb and securely braced to prevent swaying or displacement.

21.A.09 The design and construction or selection of planking and platform for means of access shall be based upon either the number of persons for which they are rated or the uniform load distribution to which they will be subjected - whichever is the more restrictive in accordance with the following tables:

RATED LOAD CAPACITY	DESIGNED AND CONSTRUCTED TO CARRY	LOAD PLACED
one person	115 kg	at center of span
two persons	115 kg 115 kg	45 cm to left of center of span and 45 cm to right of center of span
three persons	115 kg 115 kg 115 kg	at center of span and 45 cm to left of center of span and 45 cm to right of center of span

RATED LOAD CAPACITY	MAXIMUM INTENDED LOAD
light duty	1200 kg per square meter applied uniformly over entire span area
medium duty	2400 kg per square meter applied uniformly over entire span area
heavy duty	3600 kg per square meter applied uniformly over entire span area

21.A.10 Planking.

a. All wood planking shall be selected for scaffold plank use as recognized by grading rules established by a recognized independent inspection agency for the species of wood used. The maximum permissible spans for 5 cm x 25 cm (2 in x 10 in) (nominal) or 5 cm x 22.5 cm (2 in x 9 in) (rough) solid sawn wood planks shall be as follows:

Maximum intended load, Pa	Maximum permissible span - full thickness undressed lumber, m	Maximum permissible span - nominal thickness lumber, m
1,200	3.0	2.4
2,400	2.4	1.8
3,600	1.8	n/a

The maximum permissible span for 3 cm x 22.5 cm ($1^{1}/_{4}$ in x 9 in) or wider wood plank of full thickness with a maximum intended load of 50 psf shall be 1.2 m (4 ft).

b. Fabricated planks and platforms may be used in lieu of solid sawn wood planks. Maximum spans for such units shall be as recommended by the manufacturer based on the maximum intended load being calculated as specified in Table 21-1.

c. Planking shall be secured to prevent loosening, tipping, or displacement and supported or braced to prevent excessive spring or deflection; intermediate beams shall be provided to prevent dislodgement of planks due to deflection. ***> See 21.A.04***

d. Planking shall be laid with edges close together across the entire access surface: there will be no spaces through which personnel, equipment, or material could fall.

e. When planking is lapped, each plank shall lap its supports at least 30 cm (12 in).

f. Where the ends of planks abut each other to form a flush floor, the butt joint shall be at the centerline of a pole and abutted ends shall rest on separate bearers.

21.A.11 Accessways shall have overhead protection equal to 5 cm (2 in) solid planking whenever work is performed over them

or if personnel are exposed to hazards from falling objects.

21.A.12 Nails shall be driven full length; double-headed nails shall not be used on decks, guardrails, or handrails.

21.A.13 Accessways shall be inspected daily and maintained in a safe manner.

a. Accessways shall be kept free of ice, snow, grease, mud, debris or any other material or equipment which could obstruct passage, cause a tripping hazard, or render them unsafe in any other way.

b. Where accessways are slippery, abrasive material shall be used to assure safe footing.

c. All obstructions or projections into an accessway shall be removed or conspicuously marked: obstructions or projections which are sharp, pointed, or which may cause lacerations, contusions, or abrasions shall be covered with protective material.

d. Accessways, including their accessories, which become damaged or weakened shall not be used until they are repaired or replaced.

21.A.14 When moving platforms to the next level, the old platform shall be left undisturbed until the new bearers have been set to receive the platform planks.

21.A.15 Fall protection.

a. Employees shall be protected by standard guardrail, catch platforms, temporary floors, safety nets, personal fall protection devices, or the equivalent, in the following situations:

(1) on accessways (excluding ladders) or work platforms from which they may fall 1.8 m (6 ft) or more,

(2) on accessways or work platforms over water, machinery, or dangerous operations,
(3) on runways from which they may fall 1.2 m (4 ft) or more.

b. Every stairway and ladder way floor opening shall be guarded on all exposed sides, except the entrance opening, by securely anchored standard guardrail; entrance openings shall be offset or provided with a gate to prevent anyone walking into the opening.

c. Platforms, except scaffolds, 1.2 m to 1.8 m (4 ft to 6 ft) in height, having a minimum horizontal dimension in either direction of less than 115 cm (45 in) shall have standard railing installed on all open sides and ends of the platform or the workers shall use personal fall protection.

21.A.16 Training.

a. Each employee who might be exposed to fall hazards shall be trained by a competent person qualified in the following areas, in the safe use of accessways and fall protection systems and the recognition of hazards related to their use, including:

(1) the nature of access and fall hazards in the work area,
(2) the correct procedures for constructing, erecting, maintaining, using, and dismantling accessways and fall protection systems,
(3) the maximum intended load-carrying capacities of accessways and fall protection systems, and
(4) all applicable requirements from this section, and
(5) the limitations on the use of mechanical equipment during the performance of roofing work on low-sloped roofs, the correct procedures for handling and storage of equipment and materials, and the erection of overhead protection.

b. Retraining shall be provided as necessary for employees to maintain an understanding of these subjects.

c. The employer shall verify employee training by a written certification record which identifies the employee trained, the dates of the training, and the signature of the trainer.

21.B STANDARD GUARDRAILS AND HANDRAILS

21.B.01 A standard guardrail shall consist of toprails, midrails, and posts, and shall have a vertical height of 105 cm +/- 7.5 cm (42 in +/-3 in) from the upper surface of the toprail to the floor, platform, runway, or ramp level. Standard guardrail systems shall be provided with toeboards on all open sides/ends at locations where persons are required or permitted to pass or work under the elevated platform or where needed to prevent persons and material from falling from the elevated platform.

21.B.02 Guardrail systems shall be designed to meet the following requirements.

a. capable of withstanding, without failure, a force of at least 90 kg (200 lbs) applied within 5 cm (2 in) of the top edge, in any outward or downward direction, at any point along the top edge.
b. when the force described in a, above, is applied in a downward direction, the top edge of the guardrail shall not deflect to a height less than 97.5 cm (39 in) above the walking/working level.
c. midrails, screens, mesh, intermediate vertical members, solid panels, and equivalent structural members shall be capable of withstanding, without failure, a force of at least 68 kg (150 lb) applied in any downward or outward direction at any point along the midrail or other member.

21.B.03 Dimensions of standard guardrail components. The following guidelines may be used in designing guardrail systems to satisfy the requirements specified in 21.B.02. The employer is still responsible for designing a complete system and assembling these components in accordance with 21.B.02.

a. For wood railings:

(1) toprails shall be of at least 5 cm x 10 cm (2 in x 4 in) lumber,
(2) midrails shall be at least 2.5 cm x 15 cm (1 in x 6 in) lumber, and
(3) posts shall be at least 5 cm x 10 cm (2 in x 4 in) lumber spaced not to exceed 2.4 m (8 ft) on centers.

b. For pipe railings:

(1) toprails and midrails shall be at least 3.8 cm (1.5 in) nominal diameter (schedule 40 pipe) and
(2) posts shall be at least 3.8 cm (1.5 in) nominal diameter (schedule 40 steel pipe) spaced not more than 2.4 m (8 ft) on centers.

c. For structural steel railings:

(1) toprails and midrails shall be at least 5 cm x 5 cm x 1 cm (2 in x 2 in x 3/8 in) angles and
(2) posts shall be at least 5 cm x 5 cm x 1 cm (2 in x 2 in x 3/8 in) angles spaced not more than 2.4 m (8 ft) on centers.

21.B.04 Guardrail systems shall be so surfaced as to prevent injury to an employee from punctures or lacerations and to prevent snagging of clothing.

21.B.05 Toprails and midrails.

a. Midrails shall be halfway between the toprails and the floor, platform, runway, or ramp.

b. The ends of the toprails and midrails shall not overhang the terminal posts except where such overhang does not create a projection hazard.

c. Synthetic or natural fiber ropes shall not be used as toprails or midrails: wire rope may be used as toprails or midrails if

tension is maintained to provide not more than 7.5 cm (3 in) deflection, in any direction from the center line, under a 90 kg (200 lb), if support posts are located not more than 2.4 m (8 ft) apart, and if the wire rope is flagged at not more than 1.8 m (6 ft) intervals with high-visibility material.

21.B.06 Toeboards.

a. Toeboards shall be 2.5 cm x 10 cm (1 in x 4 in) (minimum 10 cm (4 in) (nominal) vertically) lumber or the equivalent.

b. Toeboards shall be securely fastened in place and have not more than 6.4 mm (1/4 in) clearance above floor level.

c. Toeboards shall be made of any substantial material, either solid or with openings not greater than 2.5 cm (1 in) in greatest dimension.

d. Where material is piled to such a height that a standard toeboard does not provide protection, paneling or screening from floor to toprail or midrail shall be provided.

21.B.07 Guardrails receiving heavy stresses from employees trucking or handling materials shall be provided additional strength by using heavier stock, closer spacing of posts, bracing, or by other means.

21.B.08 Handrails.

a. A standard handrail shall be of construction similar to a standard guardrail except that it is mounted on a wall or partition and does not include a midrail.

b. Handrails shall have smooth surfaces along the top and both sides.

c. Handrails shall have an adequate handhold for anyone grasping it to avoid falling.

d. Ends of handrails shall be constructed so as not to constitute a projection hazard.

e. The height of handrails shall be not more than 85 cm (34 in) nor less than 75 cm (30 in) from upper surface of handrail to surface of tread, in line with face of riser or to surface of ramp.

21.B.09 All handrails and railings shall be provided with a clearance of approximately 7.5 cm (3 in) between the handrail or railing and any other object.

21.C PERSONAL FALL PROTECTION DEVICES AND SAFETY NETS

21.C.01 Personal fall protection devices (personal fall arrest systems and positioning devices), independently attached or attended, or safety nets shall be used when performing such work as the following when the requirements of 22.A.04a cannot be met.

a. work in hoppers, bins, silos, tanks, or other confined spaces;
b. work on hazardous slopes, structural steel, poles;
c. erection or dismantling of safety nets;
d. tying reinforcing bars;
e. work from boatswain's chairs, swinging scaffolds, or other unguarded locations at elevations greater than 1.8 m (6 ft);
f. work on skips and platforms used in shafts by crews when the skip or cage does not block the opening to within 0.3 m (1 ft) of the sides of the shaft, unless cages are provided.

21.C.02 Selection of personal fall protective equipment shall be based on the type of work; the work environment; the weight, size, and shape of the user; the type and position of anchorage; and the length of the lanyard. ***> See Section 05.F***

21.C.03 Personal fall arrest systems, when stopping a fall, shall:

a. limit maximum arresting force on an employee to 820 kg

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(1,800 lb) when used with a body harness;
b. be rigged such that an employee can neither free fall more than 1.8 m (6 ft) nor contact any lower level or other physical hazard;
c. bring an employee to a complete stop and limit maximum deceleration distance an employee travels to 1 m (3.5 ft); and
d. have sufficient strength to withstand twice the potential impact energy of an employee free falling a distance of 1.8 m (6 ft) or the free fall distance permitted by the system, whichever is less.

21.C.04 Positioning device systems shall:

a. be rigged such that an employee cannot free fall more than 0.6 m (2 ft);
b. be secured to an anchorage capable of supporting at least twice the potential impact load of an employee's fall or 1360 kg (3,000 lb), whichever is greater.

21.C.05 Body belts and harnesses shall have two lanyards when necessary to insure that a person is tied-off with at least one lanyard at all times, or where the lanyard is the primary support for operations such as rock-scaling and high-wall concrete finishing.

21.C.06 The manufacturer's recommendations shall be followed in the fitting, adjustment, use, inspection, testing, and care of personal fall protection equipment: before an employee uses personal fall protection equipment, he/she shall receive instruction in these recommendations and the potential fall hazards of the activity.

21.C.07 Personal fall protection equipment shall be inspected before use each day to determine that it is in safe working condition: defective equipment shall be immediately replaced.

21.C.08 Personal fall protection equipment shall be used only for employee safeguarding: any such equipment subjected to impact loading shall be immediately removed from service, and shall not be used again for employee safeguarding.

21.C.09 Lifelines.

a. When vertical lifelines are used, each employee shall be attached to a separate lifeline.

b. On suspended scaffolds or similar work platforms with horizontal lifelines which may become vertical lifelines, the devices used to connect to a horizontal lifeline shall be capable of locking in both directions on the lifeline.

c. Horizontal lifelines shall be designed, installed, and used under the supervision of a qualified person as part of a complete fall arrest system which maintains a safety factor of at least two.

d. Lifelines used on rock-scaling operations or in areas where the line may be subject to cutting or abrasion shall be specifically designed and constructed for such applications.

21.C.10 Anchorage and attachment.

a. Anchorages used for attachment of personal fall arrest equipment shall be independent of any anchorage used to support or suspend platforms and shall be capable of supporting at least 2,270 kg (5,000 lb) per employee attached.

b. The attachment point for body belts shall be located in the center of the wearer's back; the attachment point for body harnesses shall be located in the center of the wearer's back near shoulder level, or above the wearer's head.

c. Personal fall arrest systems shall not be attached to guardrail systems nor shall they be attached to hoists.

d. When a personal fall arrest system is used at hoist areas, it shall be rigged to allow the movement of the employee only as

far as the edge of the walking/working surface.

21.C.11 Installation of safety nets.

a. Safety nets shall be installed as close under the work surfaces as practical but in no case more than 7.5 m (25 ft) below such work surface. Nets shall be hung with sufficient clearance to prevent contact with the surfaces or structures below: such clearance shall be determined by impact load testing. When nets are used on bridges, the potential fall area from the walking/working surface to the net shall be unobstructed.

b. Nets shall extend outward from the outermost projection of the work surface as follows:

VERTICAL DISTANCE FROM WORKING LEVEL TO HORIZONTAL PLANE OF NET	MINIMUM REQUIRED HORIZONTAL DISTANCE OF OUTER EDGE OF NET FROM EDGE OF WORKING SURFACE
up to 1.5 m	2.4 m
1.5 m up to 3.0 m	3.0 m
more than 3.0 m	4 m

c. Operations requiring safety net protection shall not be undertaken until the net(s) is in place and has been tested without failure. ***> See 05.G.02 for load testing***

21.C.12 Debris nets.

a. When used with personnel safety nets, debris nets shall be secured on top of the personnel safety net but shall not compromise the design, construction, or performance of the personnel nets.

b. A competent person shall determine, and document, the size, weight, and height-of-fall of anticipated debris: the debris netting shall have a mesh of the size and strength sufficient to contain the expected debris without penetration when properly supported.

21.C.13 Debris shall be removed from safety and debris nets; nets and debris shall be protected from sparks and hot slag resulting from welding and cutting operations.

21.C.14 Inspection of safety and debris nets.

a. Safety and debris nets shall be inspected by a competent person in accordance with the manufacturer's recommendations.

b. Inspections shall be conducted after installation, at least weekly thereafter, and following any alteration, repair, or any occurrence which could affect the integrity of the net system. Inspections shall be documented.

c. Defective nets shall not be used; defective components shall be removed from service

21.C.15 If any welding or cutting operations occur above the nets, weld protection shall be provided. The frequency of inspections shall be increased in proportion to the potential for damage to the nets.

21.C.16 Materials, scrap pieces, equipment, and tools which have fallen into the safety net shall be removed as soon as possible from the net and at least before the next work shift.

21.D LADDERS

21.D.01 The construction, installation, and use of ladders shall conform to the following, as applicable.

a. *Safety Codes for Portable Ladders*, ANSI A14.1;
b. *Portable Metal Ladders*, ANSI A14.2;

c. *Fixed Ladders*, ANSI A14.3; and
d. *Job-Made Ladders*, ANSI A14.4.

21.D.02 Length.

a. All portable ladders shall be of sufficient length and shall be placed so that workers will not stretch or assume a hazardous position.

b. Portable ladders used as temporary access shall extend at least 0.9 m (3 ft) past the landing.

(1) When a 0.9 m (3 ft) extension is not possible, a grasping device (such as a grab rail) shall be provided to assist employees in mounting and dismounting the ladder.

(2) In no case shall the length of the ladder be such that ladder deflection under a load would, by itself, cause the ladder to slip from its support.

c. The length of portable step ladders shall not exceed 6 m (20 ft).

d. When splicing is required to obtain a given length of side rail, the resulting side rail must be at least equivalent in strength to a one-piece side rail made of the same material.

21.D.03 Width.

a. The minimum clear distance between the sides of individual-rung/step ladders shall be 40 cm (16 in).

b. The minimum clear distance between side rails for all portable ladders shall be 29 cm (11.5 in).

21.D.04 Spacing of rungs, cleats, and steps.

a. On portable ladders, spacing shall be not less than 25 cm

(10 in), nor more than 35 cm (14 in), apart as measured from their centerlines.

b. On step stools, spacing shall be not less than 20 cm (8 in), nor more than 30 cm (12 in), apart as measured from their centerlines.

c. On extension trestle ladders, spacing on the base section shall be not less than 20 cm (8 in), nor more than 45 cm (18 in), apart as measured from their centerlines; on the extension section spacing shall not be less than 6 inches, nor more than 30 cm (12 in), apart as measured from their centerlines.

21.D.05 Ladders shall be surfaced so as to prevent injury to an employee from punctures or lacerations and to prevent snagging of clothing.

21.D.06 Wood ladders shall not be coated with any opaque covering, except for identification or warning labels which may be placed on only one face of a side rail.

21.D.07 A metal spreader bar or locking device shall be provided on each stepladder to hold the front and back sections in an open position.

21.D.08 Set-up.

a. Ladders shall not be placed in passageways, doorways, drives, or any locations where they may be displaced by any other work unless protected by barricades or guards.

b. Portable ladders shall be used at such a pitch that the horizontal distance from the top support to the foot of the ladder will not be greater than one-fourth the vertical distance between these points.

c. Wood job-made ladders with spliced rails shall be used at an angle such that the horizontal distance is one-eighth the length

of the ladder.

d. Ladders shall be secured by top, bottom, and intermediate fastenings as required to hold them rigidly in place and to support the loads which will be imposed upon them.

e. The steps or rungs of all ladders shall be set to provide at least 17.5 cm (7 in) toe space from the inside edge of the rung to the nearest interference.

f. The top of a non-self supporting ladder shall be placed with the two rails supported equally unless it is equipped with a single support attachment.

21.D.09 Use.

a. No work requiring lifting of heavy materials or substantial exertion shall be done from ladders.

b. When ladders are the only means of access to or from a working area for 25 or more employees, or when a ladder is to serve simultaneous two-way traffic, double-cleated ladders shall be used.

c. Portable ladders shall have slip-resistant feet.

d. Ladders shall not be moved, shifted, or extended while occupied.

e. The top or top step of a step ladder shall not be used as a step.

f. Ladders shall be inspected for visible defects on a daily basis and after any occurrence that could affect their safe use.

g. Broken or damaged ladders shall be immediately tagged "**DO NOT USE**," or similar wording, and withdrawn from service until restored to a condition meeting their original design.

21.D.10 Fixed ladders shall comply with the requirements in Appendix J.

21.D.11 Single-rail ladders shall not be used; three-legged ladders may be used for specific tasks if approved by the designated authority.

21.E STAIRWAYS

21.E.01 On all structures 6 m (20 ft) or more in height, stairways shall be provided during construction.

a. Where permanent stairways are not installed concurrently with the construction of each floor, a temporary stairway shall be provided to the work level.

b. Alternatives to the use of stairways shall be addressed in the activity hazard analysis and shall be accepted by the designated authority.

21.E.02 Design.

a. Temporary stairways shall have landings not less than 75 cm (30 in) in the direction of travel and extend at least 55 cm (22 in) in width at every 3.6 m (12 ft) or less of vertical rise.

b. Stairs shall be installed between 30^{o} and 50^{o} from horizontal.

c. Risers shall be of uniform height and treads of uniform width.

21.E.03 Metal pan landings and metal pan treads, when used, shall be secured in place and filled with concrete, wood, or other material at least to the top of each pan.

21.E.04 Wooden treads shall be nailed in place.

21.E.05 Every flight of stairs with four or more risers or rising more than 75 cm (30 in) shall have standard stair railings (defined

below) or standard handrails. ***> See 21.B for standard handrail requirements***

a. On stairways less than 1.1 m (44 in) wide having both sides enclosed, at least one standard handrail shall be installed, preferably on the right side descending.

b. On stairways less than 1.1 m (44 in) wide having one side open, at least one standard stair railing shall be installed on the open side.

c. On stairways less than 1.1 m (44 in) wide having both sides open, one standard stair railing shall be installed on each side.

d. On stairways more than 1.1 m (44 in) wide, but less than 2.2 m (88 in) wide, one standard handrail shall be installed on each enclosed side and one standard stair railing installed on each open side.

e. On stairways 2.2 m (88 in) or more wide, one standard handrail shall be installed on each enclosed side, one standard stair railing on each exposed side, and a standard handrail in the middle of the stairway.

21.E.06 Standard stair railing shall be installed around all stair wells.

21.E.07 Standard stair railing.

a. A stair railing shall have a vertical height not less than 90 cm (36 in) from the upper surface of the stair rail system to the surface of the tread, in line with the face of the riser at the forward edge of the tread.

b. Midrails, screens, mesh, intermediate vertical members, or equivalent intermediate structural members shall be provided between the toprail and the stairway steps.

(1) Midrails shall be located at a height midway between the top edge of the stairway system and the stairway steps.

(2) Screens or mesh, when used, shall extend from the toprail to the stairway steps and along the entire opening between rail supports.

(3) Intermediate vertical members, when used, shall be not more than 48 cm (19 in) apart.

(4) Other structural members, when used, shall be installed in such a manner that there are no openings in the stair rail system that are more than 48 cm (19 in) wide.

21.E.08 Doors or gates opening onto a stairway shall have a platform; swinging of the door shall not reduce the width of the platform to less than 50 cm (20 in).

21.E.09 Spiral stairways shall not be permitted except for special limited usage and secondary access where it is not practical to provide a conventional stairway.

21.F RAMPS, RUNWAYS, AND TRESTLES

21.F.01 Inclined ramps, runways, and platforms shall be as flat as conditions will permit; where the incline exceeds 1-on-5 (1 ft in a 5 ft run), traverse cleats shall be applied to the working surface.

21.F.02 Vehicle ramps, trestles, and bridges on which foot traffic is permitted shall be provided with a walkway and guardrail outside the roadway. The roadway structures shall be provided with wheel guards, fender logs, or curbs not less than 20 cm (8 in) high placed parallel and secured to the sides of the runway.

21.F.03 All locomotive and gantry crane trestles which extend into or pass over a work area, except where a crane is hoisting between rails, shall be decked solid with not less than 5 cm (2 in) planking, or the equivalent, for the full length of the extension into

the working area.

21.F.04 When used in lieu of steps, ramps shall be provided with cleats to ensure safe access.

21.G CRANE- OR DERRICK-HOISTED PERSONNEL PLATFORMS

21.G.01 The use of a crane or derrick to hoist personnel on a platform is prohibited except:

a. for routine access of employees to underground construction via a shaft;
b. when the erection, use, or dismantling of conventional means of access (e.g., personnel hoist, scaffold, ladder, aerial lift, etc.) would be more hazardous than the use of a crane or derrick hoisted personnel platform; or
c. when the erection, use, or dismantling of conventional means of reaching the worksite (e.g., personnel hoist, scaffold, ladder, aerial lift) is not possible due to structural design or workplace conditions.

21.G.02 Other requirements for crane or derrick hoisting of personnel platforms.

a. Cranes and derricks shall comply with the requirements of Section 16.

b. Personnel platforms shall comply with the requirements of Section 22.F

21.G.03 Operational criteria.

a. Hoisting of the personnel platform shall be in a slow, controlled, cautious manner with no sudden movements.

b. Load lines shall be capable of supporting, without failure, at least 7 times the maximum intended load except where rotation-resistant rope is used the lines shall be capable of supporting, without failure, at least 10 times the maximum intended load: the required design factor is achieved by taking the current safety factor of 3.5 and applying the 50% derating of the crane capacity.

c. Load and boom hoist brakes, swing brakes, and locking devices such as pawls and dogs shall be engaged when hoisted personnel are in a stationary position.

d. The crane shall be uniformly level within 1% of level grade and located on firm footing: cranes equipped with outriggers shall have them all fully deployed following manufacturer's specifications, as far as practical, when hoisting personnel.

e. The total weight of the loaded personnel platform and related rigging shall not exceed 50% of the rated capacity for the radius and configuration of the crane or derrick.

f. The use of machines having live booms is prohibited.

21.G.04 Instruments and components.

a. Cranes and derricks with variable angle booms shall be equipped with a boom angle indicator, readily visible to the operator.

b. Cranes with telescoping booms shall be equipped with a device to indicate clearly to the operator, at all times, the boom's extended length, or an accurate determination of the load radius to be used during the lift shall be made prior to hoisting personnel.

c. A positive acting device shall be used to prevent contact between the load block or overhaul ball and the boom tip (anti-two blocking device), or a system shall be used which deactivates the hoisting action before damage occurs in the

event of a two-blocking situation (two-block damage prevention feature).

d. The load line hoist drum shall have a system or device on the power train, other than the load hoist brake, which regulates the lowering rate of speed of the hoist mechanism (controlled load lowering): free-fall is prohibited.

21.G.05 Trial lift and inspection.

a. A trial lift with the unoccupied personnel platform loaded at least to the anticipated lift weight shall be made from ground level, or any other location where employees will enter the platform, to each location at which the personnel platform is to be hoisted and positioned.

(1) This trial lift shall be made immediately prior to pacing personnel on the platform.

(2) The operator shall determine that all systems, controls and safety devices are activated and functioning properly; that no interferences exist; and that all configurations necessary to reach those work locations will allow the operator to remain under the 50% limit of the hoist's rated capacity.

(3) Materials and tools to be used during the actual lift can be loaded in the platform (evenly distributed and secured) for the trial lift.

(4) A single trial lift may be performed at one time for all locations that are to be reached from a single set-up position.

b. The trial lift shall be repeated prior to hoisting employees whenever the crane or derrick is moved and set up in a new location or returned to a previously used location and when the lift route lift is changed unless the operator determines that the route change is not significant.

c. After the trial lift and just prior to hoisting employees, the platform shall be hoisted a few inches and inspected to ensure that it is secure and properly balanced.

d. A visual inspection of the crane or derrick, rigging, personnel platform, and the crane or derrick support base shall be conducted by a competent person immediately after the trial lift to determine whether the testing has exposed any defect or produced any adverse effect upon any component or structure.

e. Any defects found during inspections shall be corrected before hoisting personnel.

21.G.06 Proof testing.

a. At each job site, prior to hoisting employees on the personnel platform, and after any repair or modification, the platform and rigging shall be proof tested to 125% of the platform's rated capacity by holding it in a suspended position for five minutes with the test load evenly distributed on the platform (this may be done concurrently with the trial lift).

b. After proof testing, a competent person shall inspect the platform and rigging.

21.G.07 Employees shall not be hoisted unless the following conditions are determined to exist:

a. the load test and proof test requirements are satisfied,
b. hoist ropes are free of kinks,
c. multiple part lines are not twisted around one another,
d. the primary attachment is centered over the platform, and
e. the hoisting system is inspected if the load rope is slack to ensure all ropes are properly seated on drums and in sheaves.

21.G.08 Work practices.

a. Employees (except a designated signalperson) shall keep all

parts of the body inside the platform during raising, lowering, and positioning.

b. Before employees enter or exit a hoisted personnel platform that is not landed, the platform shall be secured to the structure, unless securing to the structure creates an unsafe situation.

c. Taglines shall be used unless their use presents a hazard.

d. The crane or derrick operator shall remain at the controls at all times, with the crane engine running, when the platform is occupied.

e. Hoisting of employees shall be discontinued upon indication of any dangerous weather conditions or other impending danger.

f. Employees being hoisted shall remain in continuous sight of and in direct communication with the operator or signal person; in situations where this is not possible, direct communication by radio shall be maintained at all times.

21.G.09 Personal fall protection.

a. Except over water, employees occupying the personnel platform shall use a body belt/harness system with a lanyard appropriately attached to the lower load block or overhaul ball or to a structural member within the personnel platform capable of supporting a fall impact for employees using the anchorage.

b. When working over water, personal floatation devices and lifesaving and safety skiffs shall be provided and used as specified in Sections 5.I and 5.J.

21.G.10 Traveling.

a. Hoisting of personnel while the crane is traveling is prohibited, except for:

(1) portal, tower, and locomotive cranes, or
(2) where it is demonstrated and documented that there is no less hazardous way to perform the work.

b. If the requirements of 21.G.10a are satisfied, the following safeguards shall be implemented while cranes travel with hoisted personnel:

(1) crane travel shall be restricted to a fixed track or runway,
(2) travel shall be limited to the load radius of the boom used during the lift,
(3) the boom must be parallel to the direction of travel,
(4) a completed trial run shall be performed to test the route of travel before employees are allowed to occupy the platform (this trial run may be performed when the trial lift required by 21.G.05 is performed), and
(5) if travel is done with a rubber-tired carrier, the condition and air pressure of the tires shall be checked; the chart capacity for lifts on rubber shall be used for application of the 50% reduction of rated capacity; outriggers may be partially retracted as necessary for travel.

21.G.11 Pre-lift meeting.

a. A meeting attended by the crane or derrick operator, signal person, employees to be lifted, and the person responsible for the task to be performed shall be held to review the appropriate requirements of this subsection (21.G) and the activity hazard analysis.

b. This meeting shall be held prior to the trial lift at each new work location and shall be repeated for any employees newly assigned to the operation.

21.H PERSONNEL HOISTS AND ELEVATORS

21.H.01 Standards for design, construction, installation or erection, operation, inspection, testing, and maintenance.

a. Design, construction, installation or erection, operation, inspection, testing, and maintenance of personnel hoists and elevators shall be in accordance with the manufacturer's recommendations and the applicable ANSI standard.

(1) Track-guided personnel hoist systems and structures which are temporarily installed inside or outside buildings during construction, alteration, or demolition shall be in compliance with ANSI 10.4, *Safety Requirements for Personnel Hoists*;
(2) Rope-guided personnel hoist systems which are temporarily erected during construction, alteration, or demolition shall be in compliance with ANSI 10.22, *Safety Requirements for Rope-guided and Nonguided Workmen's Hoists*;
(3) Nonguided personnel hoist systems which are temporarily erected during construction, alteration, or demolition shall be in compliance with ANSI A10.8, *Scaffolds, and ANSI 10.22, Safety Requirements for Rope-guided and Nonguided Workmen's Hoists*;
(4) Elevators operating in permanent hoistways on the permanent guide rails for handling personnel during construction shall be in compliance with ANSI A17.1, *Safety Code for Elevators, Dumbwaiters, Escalators, and Moving Walks*.

b. A copy of the manufacturer's manual covering construction, installation or erection, operation, inspection, testing, and maintenance and a copy of the applicable ANSI standard shall be available on site.

c. Personnel hoists and elevators shall comply with applicable requirements from Section 16, Machinery and Mechanized Equipment.

21.H.02 Personnel hoists used in bridge tower construction shall be approved by a registered engineer and erected under the supervision of a registered engineer competent in this field.

21.I ACCESS AND HAUL ROADS

21.I.01 The contractor shall construct necessary access and haul roads.

21.I.02 No employer shall move, or cause to be moved, any equipment or vehicle upon an access or haul road unless the roadway is constructed and maintained to safely accommodate the movement of the equipment or vehicle involved.

21.I.03 When road levels are above working levels, berms, barricades, or curbs shall be constructed to prevent vehicles overrunning the edge or end of embankment.

21.I.04 Roadways shall have a crown and ditches for drainage.

21.I.05 Haul roads shall be constructed to widths suitable for safe operation of the equipment at the travel speeds proposed by the contractor and accepted by the Government's designated authority.

21.I.06 Curves.

a. All curves shall have open sight line and as great a radius as practical.

b. Vehicle speed shall be limited on curves so that vehicles can be stopped within one-half the visible distance of the roadway.

c. The design of horizontal curves shall consider vehicle speed, roadway width and surfacing, and superelevation.

21.I.07 Grades.

a. When necessary, based on grade and machine and load weight, machines shall be equipped with retarders to assist in controlling downgrade descent.

b. The maximum allowable grade shall be limited to 10%.

21.I.08 Lighting shall be provided as necessary.

21.I.09 Traffic control lights, barricades, road markings, signs, and signalpersons for the safe movement of traffic shall be provided in accordance with the Federal Highway Administration's Manual on Uniform Traffic Control Devices and Section 8 of this manual.

21.I.10 For every access and haul road, a plan shall be submitted to the government's designated authority. The plan shall address the following:

a. equipment usage, traffic density, and hours of operation;
b. road layout and widths, horizontal and vertical curve data, and sight distances;
c. sign and signalperson requirements, road markings, and traffic control devices;
d. drainage controls;
e. points of contact between vehicles and the public, and safety controls at these points of contact; and
f. maintenance requirements, including roadway hardness and smoothness and dust control.

21.I.11 Roadway hardness, smoothness, and dust control shall be used to maintain the safety of the roadway.

DEFINITIONS

Body belt: a strap with means for securing about the waist and for attachment to a lanyard, lifeline, or deceleration device.

Body harness: a design of straps which is secured about the body in a manner to distribute the arresting forces over at least the thighs, waist, chest, shoulders, and pelvis, with provision for attaching a lanyard, lifeline, or deceleration device.

Deceleration device: a mechanism which serves to dissipate energy during a fall.

Double-cleated ladder: a ladder, similar to a single cleat ladder but with a center rail, which allows simultaneous two-way traffic for employees ascending or descending.

Extension trestle ladder: a ladder consisting of a trestle ladder with an additional vertical single ladder, having parallel sides, which is adjustable perpendicularly and is provided with a device to lock it into place.

Fixed ladder: a ladder that cannot be readily moved or carried because it is an integral part of a building or structure.

Hardware: buckles, D-rings, snap-hooks, and associated devices used to attach the components of a personal fall protection system.

Individual-rung/step ladder: a ladder without a side rail or center rail support, made by mounting individual steps or rungs directly to the side or wall of the structure.

Job-made ladder: a ladder fabricated by employees, typically at the construction site, and is not commercially manufactured.

Lanyard: a flexible line used to secure a body belt or body harness to a lifeline or directly to a point of anchorage.

Lifeline: a line provided for direct or indirect attachment to a worker's body belt, body harness, lanyard, or deceleration device: may be horizontal or vertical in application.

Live boom: a boom in which lowering is controlled by a brake without aid from other lowering retarding devices.

Nominal dimension: the dimension of material before it is surfaced and finished.

Nonguided personnel hoist system: a hoist system used to transport personnel in a device which is not attached to fixed tracks or guide ropes (a boatswain’s chair is an example of a non-guided personnel hoist).

Personal fall arrest system: an engineered system used to arrest an employee in a fall; consists of an anchorage, connectors, body harness, and may include a lanyard, deceleration device, lifeline, or suitable combination of these.

Personal fall protection system: an engineered system which protects employees from falls.

Positioning device: a body belt or body harness system rigged to allow an employee to be supported on an elevated vertical surface, such as a wall, and work with both hands free while leaning.

Portable ladder: a ladder that can be readily moved or carried.

Planking: a wood board or fabricated component which is used as a flooring member.

Rails: the side structural members of a ladder to which rungs, cleats, or steps are attached.

Rope grab: a device which attaches to a lifeline as an anchoring point that provides a means of arresting a fall.

Rope-guided personnel hoist system: a hoist system, used to transport personnel in a cage, which is guided by wire ropes as differentiated from a hoist system using anchored rail arrangements.

Rotation-resistant rope: a wire rope - consisting of an inner layer of strand laid in one direction covered by a layer of strand laid in the opposite direction - which has the effect of counteracting torque and reducing the tendency of the finished rope to rotate.

Runway: a personnel passageway elevated above the surrounding floor or ground level, such as a footwalk along shafting or a walkway between scaffolds.

Side-step fixed ladder: a fixed ladder which requires a person getting off at the top to step to the side of the ladder side rails to reach the landing.

Single-cleat ladder: a ladder consisting of a pair of side rails connected together by cleats, rungs, or steps.

Single-rail ladder: a portable ladder with rungs, cleats, or steps mounted on a single rail instead of the typical two rails.

Step stool: a self-supporting, foldable, portable ladder, non-adjustable in length, 80 cm (32 in) or less in height, with flat steps and without a pail shelf, designed to be climbed on the ladder top cap as well as all steps.

Through-step fixed ladder: a fixed ladder which requires a person getting off at the top to step between the side rails of the ladder to reach the landing.

Track-guided personnel hoist system: a hoist system used to transport personnel in a car which is attached to fixed tracks or guide members.

Trestle ladder: a self-supporting ladder consisting of two single ladders hinged or joined at the top to form equal angles with the base.

Trolley line: a horizontal line for direct attachment to a worker's body belt, lanyard, or deceleration device.

SECTION 22

WORK PLATFORMS

22.A GENERAL

22.A.01 Manufactured work platforms shall be erected, used, inspected, tested, maintained, and repaired in accordance with the manufacturers' recommendations as outlined in the operating manual or in accordance with guidance from the Scaffolding, Shoring, and Forming Institute. A copy of the manufacturer's recommendations (operating manual) or guidance from the Scaffolding, Shoring, and Forming Institute shall be available at the work site.

22.A.02 Work platforms shall comply with appropriate access and fall protection requirements of Section 21.

a. All requirements of Section 21.A shall be applied to work platforms and means of access.

b. Standard railing and handrails for work platforms shall be in compliance with the requirements of Section 21 and personal fall protection devices and safety nets shall be in compliance with the requirements of Section 21.C.

c. Ladders used as work platforms shall be in compliance with the requirements of Section 21.D.

22.A.03 Prior to commencing any activity which requires work in elevated areas, all provisions for access and fall protection shall be delineated in the hazard analysis, accepted by the designated authority, for the activity.

22.A.04 The following hierarchy and prohibitions shall be followed in selecting appropriate work platforms.

a. Scaffolds, platforms, or temporary floors shall be provided